Differences between V4 and V5 GPM products and possible bias correction of GMI precipitation retrievals based on precipitation system size and intensity

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Objectives:

- Compare the precipitation retrieval differences between Version5 (V5) and Version4 (V4) products by using Precipitation Features (PF) date sets.
- To investigate the possibility of using size and minimum 89 GHz PCT to improve GMI precipitation retrieval.

Data and Methods:

- The V4 and V5 data (January 2015 to December 2016) from GPM Combine and GMI has been used for the study
- The algorithm used to define the Precipitation Feature (PFs) is similar to that described in Liu et al. 2008. The DPR precipitation radar and GMI precipitation features (DPR-RGPFs) are defined by grouping the contiguous collocated pixels with precipitation detected by either combine algorithm or GMI surface precipitation rate grater than 0.1 mm hr^{-1}.
- Volumetric precipitation from GMI and Combine are inter-compared in DPR-RGPFs of different sizes, and depths.

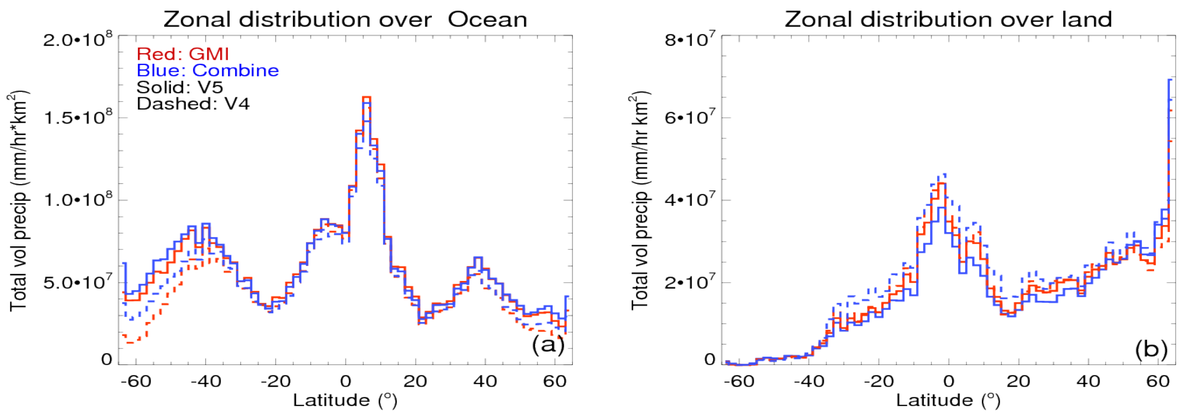

Fig 1: Zonal distribution of total volumetric precipitation from Combine and GMI over (a) ocean, (b) land. The solid and dashed lines are V5 and V4 products respectively.

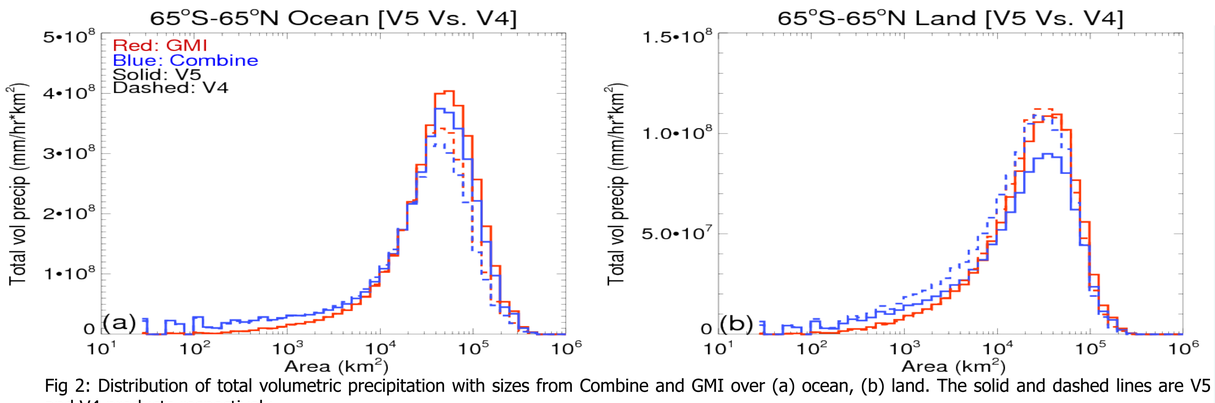

Fig 2: Distribution of total volumetric precipitation with sizes from Combine and GMI over (a) ocean, (b) land. The solid and dashed lines are V5 and V4 products respectively.

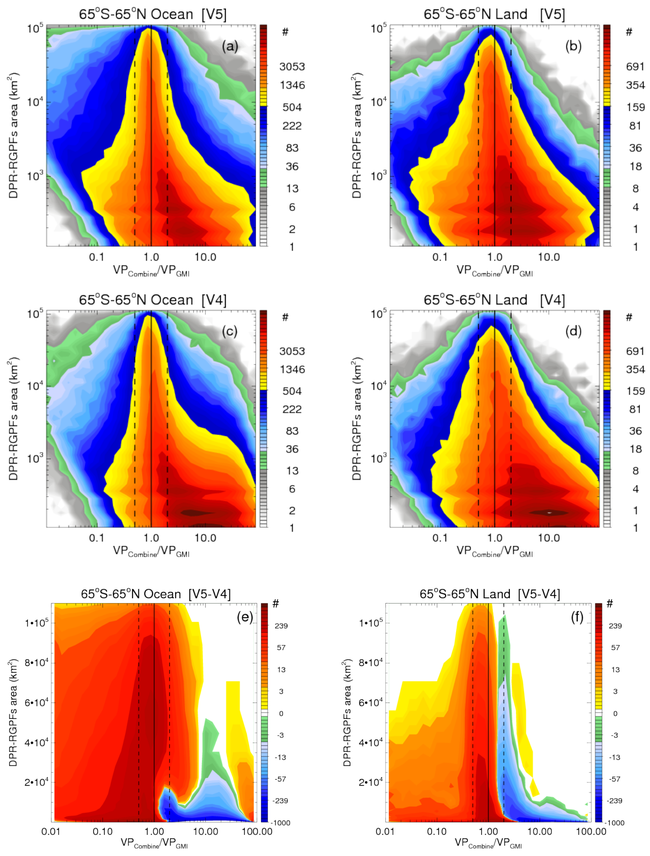

Fig 3: Two-dimensional histogram of area and ratio of Combine and GMI volumetric Precipitation of DPR-RGPFs over Ocean (left) and over Land (right) using V5 (a & b), V4 (c &d), and difference between V5 & V4 (e & f) products.

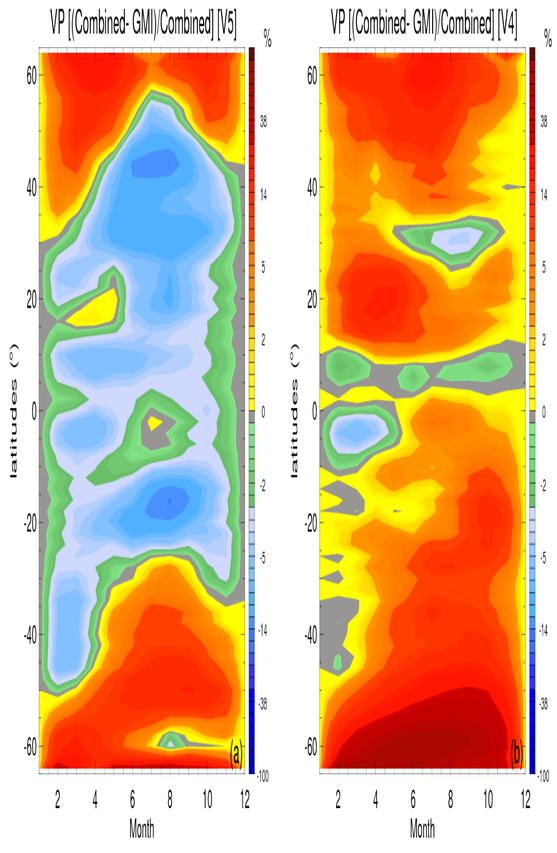

Fig 4: Seasonal variation of percentage differences between Combine and GMI volumetric precipitation using V5 (left) and V4 (right).

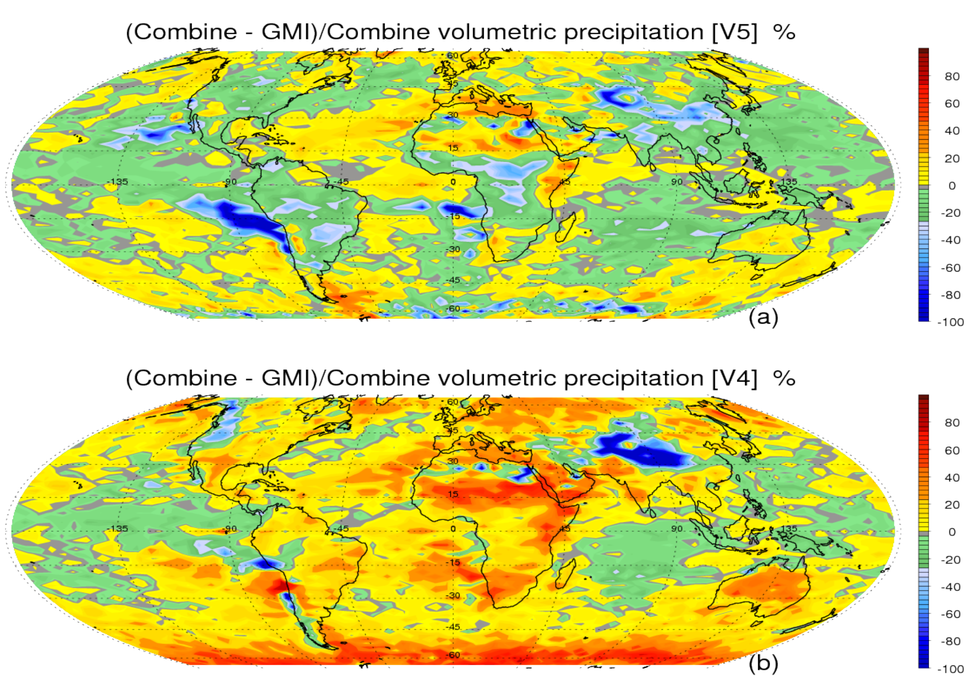

Fig 5: Difference between accumulated Combine and GMI volumetric precipitation using V5 (upper) and V4 (lower) products.

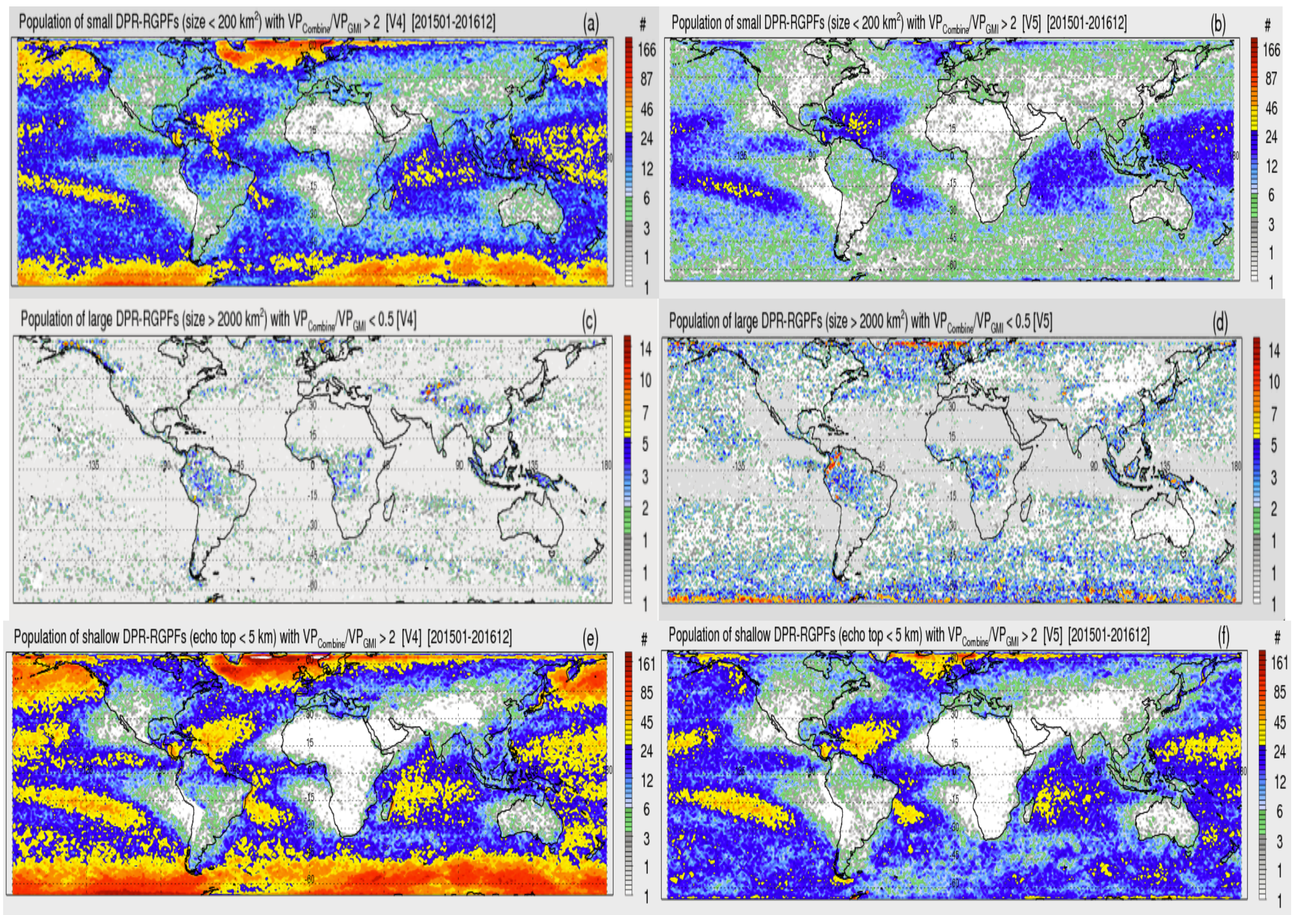

Fig 6: Geographical distribution of population of small (top), large (middle) and shallow (bottom) DPR-RGPFs with factor of two difference between volumetric precipitation of Combine and GMI. Left panels are V4 and Right panels are V5 products.

Bias calculation and correction:

- Bias factor is calculated by finding ratios of Combine and GMI volumetric precipitation with consideration of size and Minimum 89 GHz PCT of DPR-RGPFs

  Bias Factor=ΣVolprecip$_{Combine}$ / ΣVolprecip$_{GMI}$

- created with DPR-RGPFs in 40°S-40°N separately over ocean and land. The samples with elevations above 2 km are removed.
- These bias factors are used to correct the GMI volumetric precipitation.
- Biases corrected GMI= Volprecip$_{GMI}$*bias factor

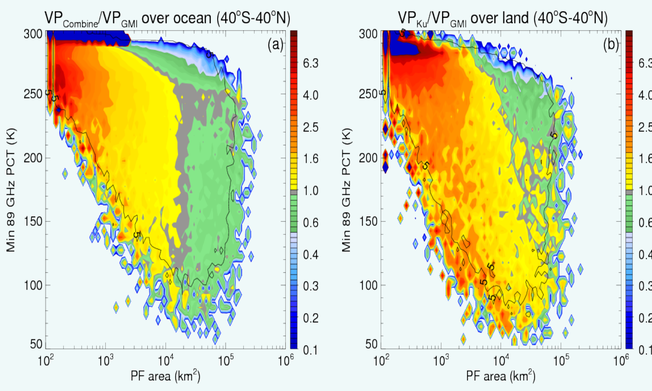

Fig 7: Histogram of ratios between accumulated precipitation of Combine and GMI in compared to min 85 GHz PCT and PFs size over ocean (left) and over land(right).

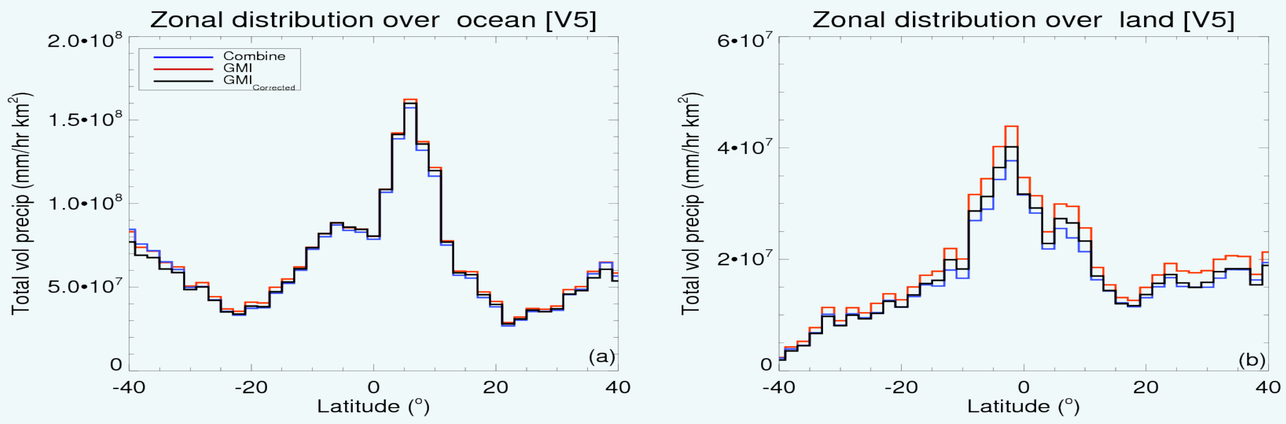

Fig 8: Zonal distribution of total volumetric precipitation from Combine, GMI, and Corrected GMI over (a) ocean, (b) land.

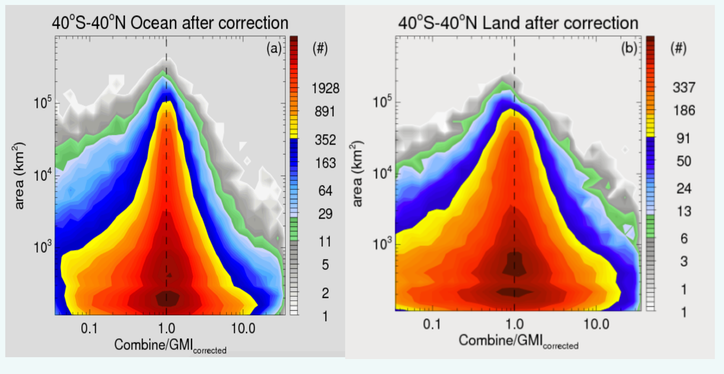

Fig 9: Two-dimensional histogram of area and ratio of Combine and GMI volumetric Precipitation of DPR-RGPFs over land (left) and over ocean (right) after the bias correction.

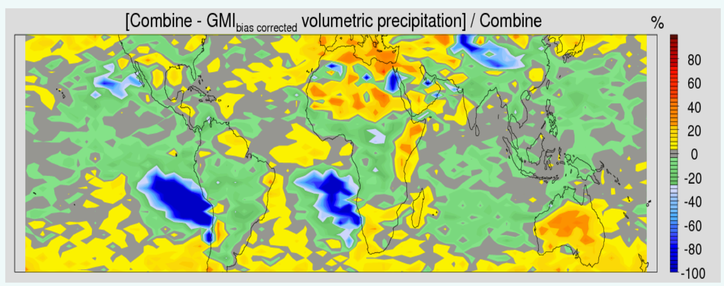

Figure 10: Difference between accumulated Combine and Corrected GMI volumetric precipitation

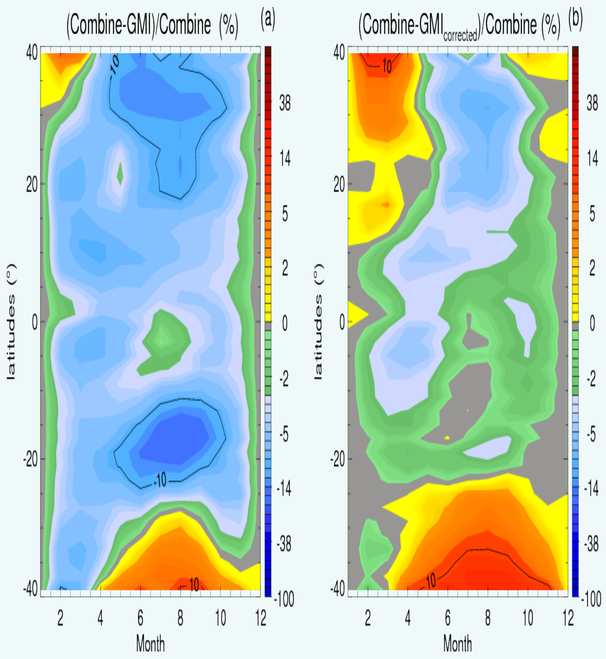

Figure 11: Seasonal variation of Percentage differences of Combine and GMI volumetric precipitation before(left) and after(right) the bias correction.

Summary:

- V5 GMI has significant improvement and more consistent with combined product over both land and ocean.
- V5 GMI is still higher than Combined in large DPR-RGPFs over land. Probably related to strong ice scattering.
- The increase of precipitation in small systems is one improvement in V5.
- GMI precipitation retrieval estimates could be improved and make it more consistent with Combine by using a simple bias correction based upon the area and minimum 89 GHz PCT. This simple bias correction is more promising over tropics.

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